

## **REMARKS**

### **Introduction**

Claims 1-11 are pending. Claims 1, 9, and 11 are amended.

In the Final Office Action mailed on April 4, 2005, the Examiner objected to claims 1-11 because of informalities and rejected claims 1-11 under 35 U.S.C. §103. For the reasons set forth in detail below, Applicants submit that the present application, including each of pending claims 1-11, is in condition for allowance.

### **Objection to claims 1-11**

The Examiner objected to claims 1-11 for the unclear use of "voltage representative current." Independent claims 1, 9, and 11 are hereby amended to further clarify the mentioned phrase. Claims 2-8 and 10 depend from independent claims 1 and 9, respectively, and accordingly include the features of claims 1 and 9. Therefore, the undersigned respectfully requests the withdrawal of this objection.

### **Rejections Under 35 U.S.C. §103**

The Examiner rejected claims 1-11, including independent claims 1, 9, and 11, under 35 U.S.C. §103 as being unpatentable over the admitted prior art, depicted in Figure 1, in view of Hugel et al (US 5,886,581) and Wilcox et al (US 5,731,694).

Two popular feedback techniques, which have been in widespread use for several years, and form the basis of Wilcox and Hugel's inventions, are briefly discussed below and the distinguishing aspects of the embodiments of the current invention will be mentioned with respect to them. The compromises of the prior art that have been accepted by their designers are overcome by the advantages of the present invention. In light of the following arguments, a *prima facie* case of obviousness under §103 has not been established in this Office Action and the undersigned requests the withdrawal of the rejections.

In the prior art, the "back EMF" sensing scheme has a significant problem since it depends on the design and variability of the step-up transformer. The flyback voltage at the primary is a strong function of the design and manufacture of the step-up transformers. Leakage inductance (poor coupling) between the primary and the secondary causes ringing at the beginning of the pedestal step. This ringing must be absorbed with some sort of damper network – usually a damper diode, capacitor, and resistor. The damping time will be larger for larger values of leakage inductance. Because these transformers are designed for minimum leakage inductance, this parameter tends to vary greatly across the production spread and from vendor to vendor.

If the time constant of the damping network is too large (too long) or too small (too short), the leading edge of the flyback pedestal can be severely rounded or can have a significant overshoot spike. As a result of this variability, the sample time for the "feedback" signal must be delayed until after the energy in the leakage inductance has been damped out. Although the magnetic element in this application is thought of as a step-up transformer, it is really a "coupled inductor", i.e. an inductor with two windings. All of these "transformers" are made with gapped cores in order to control the magnetizing inductance which sets the ripple current in the windings. Therefore, the magnetizing inductance is relatively small in order to reduce the size and cost of the transformer.

This means that the flyback pedestal will normally exhibit significant "droop" before the next "on-time" begins. Thus, the sample time for the "feedback" signal must be made as early in the flyback pedestal as possible. This requirement conflicts with the requirement to delay the sample time until after the energy in the leakage inductance has damped out.

As a result of these conflicting requirements, the technique of measuring the output voltage via the flyback pedestal voltage is not very accurate and yields unacceptable variations across the production spread and from one application to another, with the result that a camera flash intensity varies and so the photograph quality varies from unit to unit.

The benefit of the flyback pedestal sampling technique is that it does not absorb charge from the output reservoir capacitor. Unfortunately, in order to sample the output voltage level, it is necessary to execute a complete power cycle by charging the inductor and dumping the energy into the output. Generally, the energy consumed by a power cycle is unacceptably large, even when it is done infrequently, and this leads to shortened battery life in portable equipment.

Thus, the Back EMF sensing technique exhibits poor voltage regulation accuracy across the production spread and must sample the output voltage periodically in order to ensure the output reservoir is still charged up. The result is poor control of the flash energy across the production spread and shortened battery life. In general, the "back EMF" sensing scheme has a significant problem in that it depends on the design and variability of the step-up transformer.

A second approach to solving this problem is to simply monitor the capacitor voltage with a resistive divider – directly feed back the parameter to be controlled. This minimizes the variation of flash intensity across the production spread because the resistors in the divider can be very accurate. Unfortunately, there is a flaw in the conventional approach to this solution – the resistors must have a relatively low value.

The operating frequency of the flyback converter in a portable camera is dictated by the space available for the transformer. In order to make the transformer small, it is necessary to operate at a high frequency. In order for the feedback loop to respond at such a high frequency, it is necessary to have a reasonably small time constant at the feedback input. Since the module designer cannot change the capacitance at the feedback input inside the IC, the external resistors must be made relatively small. This means that the reservoir capacitor will be discharged fairly fast by the feedback resistors and the converter will have to be powered up and cycled frequently to maintain the output voltage.

To work around this problem, the module designers have added a second high-voltage, fast-switching diode and a small high-voltage capacitor in order to isolate the main output reservoir capacitor from the feedback resistors. The additional components

are relatively expensive and take up precious room in the module. A further complication is that (like the Back EMF solution) the converter must be cycled periodically even after the main output reservoir capacitor has been charged up in order to sample the voltage at the output. Thus, the simple approach of adding a resistive divider to feed back the output voltage solves only one of the problems left by the Back EMF sensing technique – the flash intensity is uniform across the production spread but the battery life is shortened because of the need to re-sample the output voltage.

To eliminate the above mentioned compromises one must maintain the precision and repeatability of the resistive divider while reducing the drain on the battery, which can be done if one raises the impedance of the feedback resistors by an order of magnitude and maintain the bandwidth of the feedback path. This is accomplished by the disclosed embodiments of the invention.

As seen from the above argument, the converter that charges the reservoir capacitor for the camera flash has special requirements. The module must be small and efficient. The converter must operate at a high frequency. The output voltage must be well-controlled across the production spread. The output sampling method must not discharge the reservoir capacitor at a significant rate. A precise, fast, and high-impedance feedback network is needed, which is absent in the admitted and cited prior art, individually or collectively.

In Hugel, the input to the high-speed transimpedance amplifier (Figure 4, element 60) is not the controlled node. Hugel regulates the output of the high-speed transimpedance amplifier with an arbitrarily slow operational amplifier (Figure 4, element 64) and computes the error term of the servo loop at a node that is relatively low impedance (Figure 4, element 68). Also, in Wilcox, the current summing node is similarly driven by fairly low impedances (Figure 2, elements 38A and 39).

Please note that if the use of a transimpedance amplifier to feed back the voltage on a high-voltage capacitor were obvious, this solution would have been integrated into an ASIC for cameras years ago and millions of cameras would not be flashing inconsistently and quickly discharging their batteries. Therefore, change from an

operational amplifier to a transimpedance amplifier is not obvious when looking at the parasitic capacitance at the amplifier input.

In a true transimpedance the input is purely current driven because the input's voltage is relatively constant. A relatively constant voltage cancels the parasitic capacitance at the input of the amplifier due to zero induced current in the parasitic capacitor at a constant voltage. This point appears not to be taught of in any of the references cited. The Examiner analysis states that the reference patents teach that the interchange of an operational amplifier and a transimpedance amplifier is obvious. If this is so then how can the change of a transimpedance amplifier into an operational amplifier result in failure of the design? The change from transimpedance amplifier to an operational amplifier in this case is, therefore, not obvious.

For the reasons discussed above and for the additional features of the independent claims 1, 9 and 11, a *prima facie* case of obviousness under §103 has not been established with respect to these claims and accordingly the undersigned requests the withdrawal of the §103 rejection of independent claims 1, 9 and 11.

Claims 2-8 and 10 depend from independent claims 1 and 9, respectively, and accordingly include the features of claims 1 and 9. For reasons discussed above a *prima facie* case of obviousness under §103 has not been established with respect to the base claims 1, 9 and 11 and accordingly the undersigned requests the withdrawal of the rejections of dependent claims 2-8 and 10.

## **Conclusion**

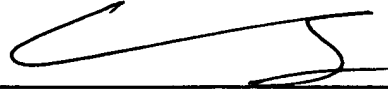
In view of the foregoing, the claims pending in the application comply with the requirements of 35 U.S.C. § 112 and patentably define over the applied art. A Notice of Allowance is, therefore, respectfully requested. If the Examiner has any questions or believes a telephone conference would expedite prosecution of this application, the Examiner is encouraged to call the undersigned at (206) 359-6488.

Applicant encloses the appropriate fee with this response. However, if a fee is due, please charge our Deposit Account No. 50-0665, under Order No. 386168016US from which the undersigned is authorized to draw.

Date: 9/28/05

Respectfully submitted,

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